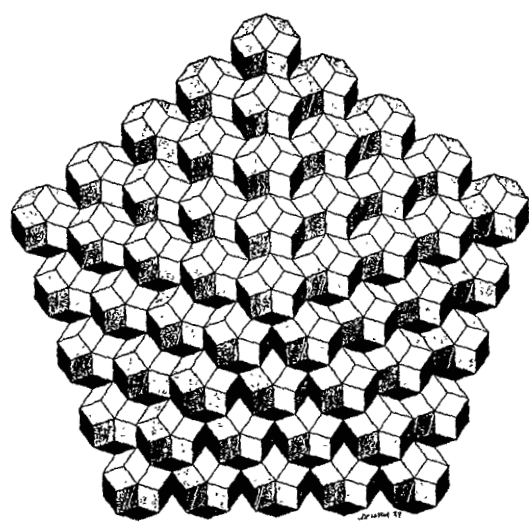# Symmetry

of

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Abstracts

II.

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THE SYMMETRY OF STRUCTURE IN THE GENERATION OF POLYHEDRAL LATTICES

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In defining a systematic process, it is always difficult to decide whether to begin with the whole system and break it down into its primitive elements or to begin with the elements and demonstrate how they generate the whole. I have taken advice from Piaget (1968, p. 141): "Genesis is simply a transition from one structure to another, nothing more; but this transition always leads from a `weaker' to a `stronger' structure; it is a formative transition. Structure is simply a system of transformations, but its roots are operational; it depends, therefore, on prior formation of the instruments of transformation rules and laws."

I have composed three first generation tables of eighty polyhedra each. A look at their general organizational differences leads to their elemental instruments of formation. I think of polyhedra as internally regulated forms poised in a process of evolution rather than as permanent individual structures. Even though the forms in these tables define conventional polyhedra, the assemblage route to their formation is not a conventional method of construction but a tranformational process of generation.

Slide 1. Three different periodic arrangements of the same 80
          polyhedral lattices.

	circumferential	radial
a.	20-20	20-20
b.	40	40
c.	canine: 50	bovine: 30

Angular Polyhedral Lattices

The 80 lattices, generated from elemental units, manifest as lines and junctions (vertices) I call foundation sutures. The foundation suture elements contain the equatorial junction valences that join the hemispheres of a polyhedral lattice. A second structural element I call caps provides the mechanics for polar closure. These two formational elements together, sutures and caps, form a template. The template, an irreducible reservoir of pairs of structural elements, contains the instruments of formation. There are two species of foundation sutures, canine and bovine, and two kinds of capping operations, circumferential and radial. When these elements are symmetrically coordinated, they generate the 80 polyhedral lattices.

Slide 2. Elemental template.

The process for coordinating the sutures and caps is one of simple numerical symmetry. The elements correspond with each other in a fundamental 2, 3, 4, 5 and 6 unit evolution. Twist establishes the up and down (z) axes of symmetry. Those lattices that twist upon their axes of symmetry are called primary (p) and those that untwist are called secondary (s).

Slide 3. Demonstration of the process of assemblage with the simplest lattice in each domain.

      a. canine tetrahedron:

         2-D suture   3-D ring   (p) capped (s)
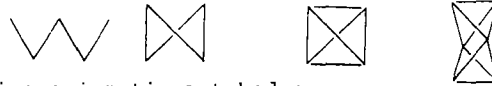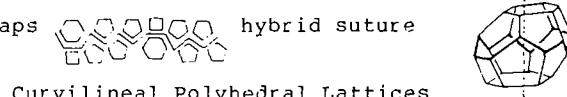
      b. bovine prismatic octahedron:

         2-D suture   3-D ring   (p) capped (s)

Slide 4. Analysis of R.E. Williams 6-fold betatetrakaidecahedron.

   caps   hybrid suture

Curvilineal Polyhedral Lattices

Conventional polyhedral lattices may be converted to curvilineal forms via this form generating method. The curvilineal forms are topologically equivalent to the angular lattices because the vertices are conserved in the process of conversion and, consequently, even though their shapes change drastically, the facial areas and vertices remain in the same locations as in the conventional angular polyhedra. The straight lines of the foundation sutures become twisted loops and the straight lines of the caps become arcs.

Slide 5. Conversion from angular to curvilineal.

                 suture   capped   suture   capped

      a. tetrahedron:

      b. hexahedron: suture   capped   suture   capped
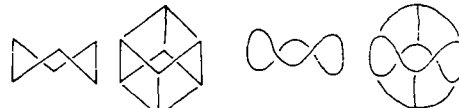
Loop Generation

There is yet another formational level where conventional polyhedral lattices are transformed to 3-D rings of twisted loops. These configurations are not, however, topologically equivalent to the conventional polyhedral lattices because all of the vertices are

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absorbed in the lineal conversion process. The primitive neutral form of the looping configurations is an unknotted linear ring that evolves from simple to complex in accordance with the number of twisted loops that it acquires. The twisted loop pathways are based upon the same geometric coordinates as conventional lattices, but the lineal orbits are continuous and junctionless. The unique attribute contained in the loop dynamics is in the capability to produce both exostructural and endostructural modes.

Slide 6. Two phases in the loop transformation.

       a. the five Platonic angular loops
       b. table of curvilineal twisted loops

The elements for the loop configurations are single loops and double loops. Single loops twist right or twist left individually and double loops twist right and left simultaneously.

Slide 7. Loop dynamics.

       a. single and double loop elements
       b. exostructural and endostructural gymnastics

Summary

Schooled in the arts but, over the years not finding enough either in the history of art or in the contemporary forms of art to hold my attention, I turned to reading about the scientific approaches to structure. This is a reversal of the experience of Smith (1981, p. 358) "I have slowly come to realize that the analytical quantitative approach that I have been taught to regard as the only respectable one for a scientist is insufficient. Analytical atomism is beyond a doubt an essential requisite for the understanding of things, and the achievements of the sciences during the last four centuries must rank with the greatest achievements of man at any time: yet, granting this, one must still acknowledge that the richest aspects of any large complicated system arise in factors that cannot be measured easily, if at all. For these, the artist's approach, uncertain though it inevitably is, seems to convey more meaning." In my schooling, I was allowed to miss the analytical approach altogether. The greatest impact upon my thinking as an artist came later and was the discovery of the Einstein-relativity/Bohr-quantum theory dialogues. This has projected me into a new heretofore unforeseeable level of possibilities.

Slide 8. These slides show some of my information sources plus some of the forms of art that I am now producing.

       a. natural patterns containing the foundation
          suture and orbital loop elements.
       b. collages with combined natural materials.
       c. sculptures based upon information found mostly
          in the junction patterns of natural systems.

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